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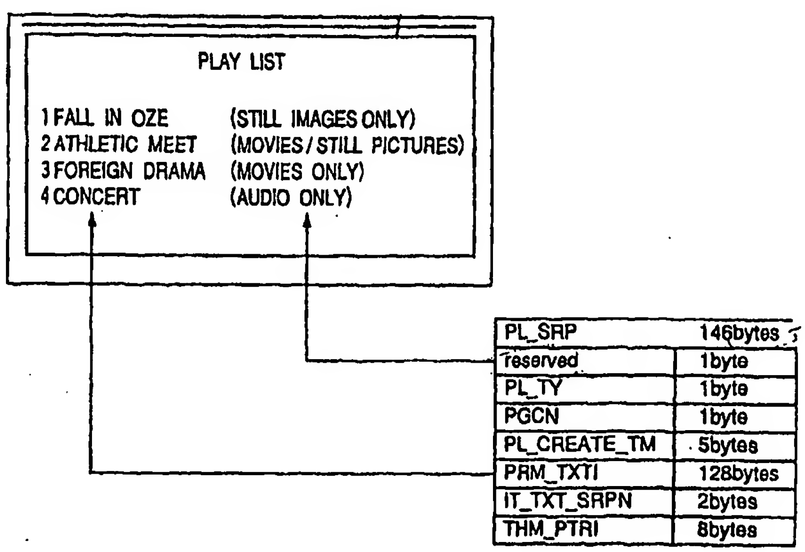

(57) Abstract

Output obtained during playback, and operations available during playback, differ according to the content of the reproduction path being played from an optical disc storing plural reproduction paths containing plural different types of audio and/or image information. Content type information indicative of the specific audio and/or video content of each reproduction path is stored for each reproduction path on the optical disc. This information is then presented to the user on a reproduction path (program or play list) selection screen to inform the user and assist in the play list selection process. Operation of the disc player or disc editor can be changed appropriately to this content type information.

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DESCRIPTION

OPTICAL DISC, RECORDING DEVICE AND REPRODUCING DEVICE

Technical Field

The present invention relates to a readable and writable optical disc, and to a recording device and a reproducing device for the optical disk. More particularly, the present invention relates to an optical disc for recording multimedia data including moving picture data, still picture data, and audio data, and to a recording device and a reproducing device for this optical disc.

Background Art

Rewritable optical discs have for years had a maximum storage capacity of approximately 650 MB, but this has been changed by the development of phase change type DVD-RAM discs with a capacity of several gigabytes. Combined with the adoption of MPEG, and particularly MPEG-2, standards for encoding digital AV data, DVD-RAM is widely anticipated as a recording and reproducing medium with application in the AV industry as well as the computer industry. More specifically, DVD-RAM media are expected to replace magnetic tape as the storage medium

of choice for AV recordings.

DVD-RAM

Increases in the storage density of rewritable optical disc media over the last few years has made it possible to use such media for applications ranging from storing computer data and recording audio data to recording image data, including movies.

The signal recording surface of a conventional optical disc is typically formatted with lands and grooves, one of which is used as a guide groove for signal recording and reproducing. The data signal is then recorded using only the land or the groove. With the advent of the land and groove recording method, however, it became possible to record signals to both the land and groove. This development approximately doubled the storage capacity of the disc. (See, for example, Japanese Unexamined Patent Application (*kokai*) 8-7282.)

Further development of a zone CLV (constant linear velocity) method simplified and made it easy to implement a CLV recording and reproducing technique, an effective means of further increasing the recording density. (See, for example, Japanese Unexamined Patent Application (*kokai*) 7-93873.)

A major topic left for future development is how

to use such potentially high capacity optical disc media to record AV data containing image data to achieve new functions and performance far surpassing conventional AV products.

With the introduction of high capacity rewritable optical disc media, optical discs are widely expected to replace conventional tape media for recording and reproducing AV content. The transition from tape to disc recording media is also expected to greatly affect both the performance and functions of AV recording and reproducing products.

One of the greatest benefits of a transition to disc is a significant improvement in random access performance. While random access to tape content is possible, it generally takes on the order of minutes to rewind a full tape. This is several orders slower than the typical seek time of optical disc media, which is on the order of at most several ten milliseconds. Tape is therefore considered, for practical purposes, not to be a random access medium.

The random access capability of optical disc media has also made possible distributed, that is, noncontiguous, recording of AV data, which is not possible with conventional tape.

Fig. 34 is a block diagram of the drive device of a

DVD recorder. As shown in Fig. 34, this DVD recorder comprises an optical pickup 11 for reading data from the disc 10, an ECC (error correction code) processor 12, track buffer 13, switch 14 for changing track buffer input/output, encoder 15, and decoder 16. An enlarged view of the disc 17 format is also shown.

As indicated by the disc 17 format, the smallest unit used for recording data to a DVD-RAM disc is the sector, which is 2 KB. Sixteen sectors are combined as one ECC block, to which the ECC processor 12 applies error correction coding.

The track buffer 13 is used for recording AV data at a variable bit rate in order to record AV data to a DVD-RAM disc more efficiently. While the read/write rate (Va) to a DVD-RAM disc is fixed, the bit rate (Vb) of the AV data is variable, based on the complexity of the AV data content (e.g., images if the AV data is video). The track buffer 13 is used to absorb this bit rate difference. This means that the track buffer 13 is unnecessary if the AV data bit rate is also fixed, as it is in the Video CD format.

This track buffer 13 can be even more effectively used by dispersed placement of the AV data on the disc. This is explained with reference to Fig. 35.

Fig. 35 (a) shows the disc address space. If the AV data is recorded divided between contiguous area A1

between addresses a1 and a2, and contiguous area A2 between a3 and a4 as shown in Fig. 35 (a), the AV data can be continuously reproduced from these non-contiguous areas A1 and A2 by supplying data accumulated in the track buffer 13 to the decoder while the optical head seeks from a2 to a3. This is shown in Fig. 35 (b).

Once reading AV data starts from a1 at time t1, it is both input to the track buffer 13 and output from the track buffer 13 with data accumulating in the track buffer at the rate (Va-Vb), that is, the difference between the input rate Va to the track buffer and the output rate Vb from the track buffer. This continues to address a2 at time t2. Assuming that the data volume accumulated to the track buffer at this time is B(t2), data supply to the decoder can continue until the data B(t2) accumulated to the track buffer is depleted at time t3 at which reading resumes from address a3.

In other words, if it is assured that a certain volume of data (a1, a2) is read before a seek operation is performed, AV data can be continuously supplied to the decoder while the seek is in progress.

It should be noted that this example considers reading, that is, reproducing, data from DVD-RAM, but the same concept applies for writing or recording data to DVD-RAM.

It will thus be obvious that insofar as a specified amount of data is recorded continuously to DVD-RAM disc, continuous reproduction and recording is possible even if the AV data is noncontiguously recorded to the disc.

MPEG

A common AV data format is described next below.

As noted above, AV data is recorded to DVD-RAM media using the MPEG international standard, also known as ISO/IEC 13818.

Even though DVD-RAM discs have a large, plural gigabyte, capacity, this is still not sufficient for recording uncompressed digital AV data of any duration. A way to compress and record AV data is therefore necessary. This need was addressed by worldwide adoption of the MPEG (ISO/IEC 13818) standard for AV data compression. MPEG decoders (compression/decompression ICs) have also been realized with advances in IC devices. This has enabled the DVD recorder to handle MPEG compression and decompression internally.

MPEG signal processing is able to achieve high efficiency data compression chiefly as a result of the following two features.

First is that compression using a time correlation

characteristic between frames (known as pictures in MPEG) is used in conjunction with conventional compression using a spatial frequency characteristic for moving picture data compression. Each video sequence of an MPEG video signal stream is divided into one or more groups of pictures, each group of pictures comprising one or more pictures of three different types: I-pictures (intraframe coded pictures), P-pictures (predictive-coded pictures, that is, intracoded with reference to a preceding picture), and B-pictures (bidirectionally predictive-coded pictures, that is, intraframe coded with reference to preceding and following pictures).

Fig. 36 shows the relationship between I, P, and B pictures. As shown in Fig. 36, P-pictures refer to temporally preceding I- or P-pictures in the sequence, while B-pictures refer to the first preceding and following I- or P-pictures. It should also be noted that because B-pictures reference an upcoming I- or P-picture, the display order of the pictures may not match the coding order of the pictures in the compressed data bitstream.

The second feature of MPEG coding is that code size is dynamically allocated by picture unit according to the complexity of the image. An MPEG decoder has an input buffer, and by accumulating data in this decoder buffer a large amount of code can be allocated to complex images

that are difficult to compress.

Three types of audio coding are used for the audio portion of a DVD-RAM recording: MPEG audio with data compression, Dolby Digital(R) (also known as AC-3), and noncompressive linear pulse code modulation (LPCM). Both Dolby Digital(R) and LPCM are fixed bit rate coding methods, but MPEG audio coding can select from several compression rates on an audio frame basis, although audio compression is not as high as video stream compression.

The resulting compressed video and audio streams are multiplexed to a single stream using a method known as the MPEG system. Fig. 37 shows the organization of an MPEG system stream. As shown in Fig. 37, each 2 KB sector comprises a pack header 41, packet header 42, and payload 43. The MPEG system thus has a hierarchical structure comprising packs and packets. Each packet comprises a packet header 42 and payload 43. AV data is segmented from the beginning into blocks of an appropriate size for storage to the payload 43.

The packet header 42 records information referring to the AV data stored in the associated payload 43. More specifically, the packet header 42 contains a stream ID for identifying the data stored in the associated packet, and a decoding time stamp (DTS) and presentation time stamp (PTS) identifying the decoding time and presentation

time of the data contained in the payload in 90 kHz precision. If the decoding and presentation are simultaneous, as in the case of audio data, the DTS can be omitted.

A pack is a unit of plural packets. In DVD-RAM, however, there is one pack for each packet, and each pack therefore comprises a pack header 41 and packet (containing a packet header 42 and payload 43).

The pack header contains a system clock reference (SCR) expressing with 27 MHz precision the time at which the data contained in this pack is input to the decoder buffer.

An MPEG system stream thus comprised is recorded one pack to a sector (= 2048 bytes) on DVD-RAM.

A decoder for decoding the above-noted MPEG system stream is described next below. Fig. 38 is a block diagram of an exemplary decoder model (P_STD) of an MPEG system stream decoder. Shown in Fig. 38 are the system time clock (STC) 51, that is, the internal reference clock for decoder operation; a demultiplexer 52 for decoding (demultiplexing) the system stream; video decoder input buffer (video buffer) 53; video decoder 54; re-ordering buffer 55 for temporarily storing I and P pictures to absorb the difference in the coding (data) sequence and presentation sequence that occurs between B pictures and I

and P pictures; a switch 56 for adjusting the output order of the I, P, and B pictures buffered to the re-ordering buffer 55; an audio decoder input buffer (audio buffer) 57; and audio decoder 58.

This MPEG system decoder processes the above-noted MPEG system stream as follows.

When the time indicated by the STC 51 and the SCR written to the pack header match, the pack is input to the demultiplexer 52. The demultiplexer 52 then interprets the stream ID in the packet header, and passes the audio stream and video stream contained in the payload data to the appropriate decoder buffers. The PTS and DTS are also read from the packet header.

When the times indicated by the STC 51 and DTS match, the video decoder 54 reads and decodes the picture data from the video buffer 53. I and P pictures are stored to the re-ordering buffer 55 while B pictures are presented directly to screen. If the picture being decoded by the video decoder 54 is an I or P picture, the switch 56 switches to the re-ordering buffer 55 to output the previous I or P picture from the re-ordering buffer 55; if a B picture is decoded, the switch 56 switches to the video decoder 54.

Similarly to the video decoder 54, the audio decoder 58 reads and decodes one audio frame of data from the audio buffer 57 when the PTS matches the STC 51

(a DTS is not recorded for audio data).

An exemplary method of multiplexing an MPEG system stream is described next with reference to Fig. 39. Note that a sequence of video frames is shown in Fig. 39 (a), the change in data storage to the video buffer is shown in Fig. 39 (b), a typical MPEG system stream is shown in Fig. 39 (c), and an audio signal is shown in Fig. 39 (d). Each of Figs. 39 (a) to (d) are shown on a common time base (horizontal axis). The vertical axis in Fig. 39 (b) indicates the amount of data stored to the video buffer. The bold line in this graph thus indicates the change over time in the buffered video data volume. The slope of this line is indicative of the video bit rate, and shows that data is input to the video buffer at a constant rate. The decrease in buffered data at regular intervals indicates the progression of data decoding. The intersection of the dotted line extension of the graphed line with the time base (horizontal axis) indicates the time at which video frame transfer to the video buffer begins.

MPEG encoding is described next using by way of example coding a complex image A in the video data stream. As shown in Fig. 39 (b), image A requires a large coding block, and data transfer to the video buffer must therefore begin from a time t1 before the image A decoding time. Note that the time from data input start time t1 to decoding

is referred to as vbv_delay below. AV data is thus multiplexed to the position (time) of the shaded video pack.

Unlike video data, audio data does not require dynamic coding size control. It is therefore not necessary for audio data transfer to start at a similarly advanced time before decoding starts, and audio data is thus typically multiplexed only slightly before decoding starts. Video data is thus multiplexed to the MPEG system stream before the audio data.

It should be further noted that data can be accumulated to the buffer for a limited time in the MPEG system. More specifically, the MPEG system standard requires all data other than still picture (or still image) data be output to the decoder from the buffer within one second of being stored to the buffer. This means that there is at most a one second offset between video data and audio data multiplexing (or more precisely, the time required for video frame reordering).

It will also be obvious that while the MPEG system stream is described above with video data preceding the audio, the audio can theoretically precede the video. This type of stream can be purposely generated by using for the video data simple images to which a high compression rate can be applied, and transferring the audio data earlier than required. Even in this case, however, the

audio can precede the video by at most one second due to the restrictions imposed by the MPEG standard.

Reproduction path

The AV data reproduction path is described next below.

As described above, data is recorded and reproduced from a simple linear path when using magnetic tape and other sequential access media. When plural AV streams are sequentially recorded to a single tape, the playback head must first be indexed to the desired stream before playback can start. Because output will be interrupted if a seek (head indexing) operation is performed to skip to another location on the tape while playback is in progress, AV streams by necessity must be linearly reproduced.

When using a random access medium such as optical discs, however, the high speed access capability of such media makes it possible to sustain continuous, uninterrupted output within certain parameters even when the playback head moves to AV data at a non-contiguous location on the disc by simply providing a track buffer of sufficient size between the decoder and drive.

It is therefore possible to define a plurality of playback (reproduction) paths on optical disc media. For

example, discs conforming to the DVD-ROM video standard (DVD Specifications for Read-Only Disc, Part 3, Video Specifications) can be recorded so that the user can enjoy various different reproduction paths presenting different program content. Moving picture data, still picture data, audio, captioning data, and various other types of AV data can also be mixed in a single reproduction path for even greater variety.

Disclosure Of Invention

The object of the present invention is to provide a DVD recorder that solves the following problems hindering obtaining maximum performance from DVD-RAM media, a high capacity rewritable storage medium widely anticipated as the next generation in AV recording media.

The greatest problem resulting from a DVD recorder being able to define a plurality of reproduction paths is presenting these paths to the user. Multiple reproduction paths enhances user enjoyment, but can also lead to user confusion. That is, the availability of multiple reproduction paths makes it harder for the user to pick the desired path satisfying the user's personal objectives and desires. Further confusion can arise when the user does not know what type(s) of AV data are present on the various reproduction paths before playback starts.

For example, if the reproduction path comprises only moving picture content, the user can enjoy the program content until the AV stream ends without further manipulation required. However, if the reproduction path contains a group of still pictures, some type of operation is typically needed to continue to the next image. Furthermore, while there is obviously no video involved when reproducing an audio-only stream, if the user does not know that there is no associated video content to be reproduced with the audio, equipment failure or simply misunderstanding could result.

DVD-ROM video discs are frequently programmed with an easy to understand menu to the disc contents. This menu is prepared by the content creator, and also draws from the AV data content of the disc. Other information is also presented on the disc jacket or disc surface to inform the user.

With rewritable media such as DVD-RAM, however, the AV data content as well as reproduction path definitions can change, and the above-noted methods used with DVD-ROM are not as easily used.

The greatest problem in this regard with DVD-RAM and other rewritable media when using multiple reproduction paths is therefore achieving a method whereby reproduction path information can be appropriately

presented to the user using the most recent data written to disc.

To achieve the above object, our invention relates to an optical disc for storing an AV stream containing at least one moving picture (video) stream or still picture (still image) stream, and management information for managing the AV stream wherein the management information comprises reproduction path information (UD_PGCI) generated by a user specifying a starting point and an ending point for a desired part of the AV stream, and play list type information (PL_TY) indicating whether the content of the user-defined reproduction path specified in the reproduction path information (UD_PGCI) is only video content, only still picture content, or a mixture of video and still picture content.

Our invention further relates to an optical disc for recording an AV stream containing at least one video or still picture stream, or an audio stream with no video or still picture content, and management information for managing the AV stream. In this case, the management information comprises reproduction path information (UD_PGCI) generated by a user specifying a starting point and an ending point for a desired part of the AV stream, and play list type information (PL_TY) indicating whether the content of the reproduction path specified in the reproduction path

information (UD_PGCI) is only video content, only still picture content, a mixture of video and still picture content, or only audio content with no video or still picture content.

The play list information stored in the management information can be used to inform the user what type of content will be presented from each reproduction path before playback starts.

Further preferably in both cases above, the management information also comprises primary text information (PRM_TXTI) containing titles for the reproduction path information (UD_PGCI).

By storing title information for each user-defined reproduction path, a more informative, user-friendly display can be presented when informing the user of reproduction path content.

Our invention further relates to a recording device for recording management information to an optical disc of our invention as noted above. This recording device comprises memory for storing a user-defined starting point and ending point for a desired part of the AV stream; a means for generating user-defined reproduction path information based on the starting point and ending point stored to memory; a means (7802, steps #20 to #26) for generating play list type information (PL_TY) indicating whether the content of a user-defined reproduction path is

only video content, only still picture content, or a mixture of video and still picture content; and a means for recording the reproduction path information and play list type information to the optical disc as management information.

Our invention yet further relates to a playback device for reproducing content from an optical disc to which an AV stream containing at least one video or still picture stream, and management information for managing the AV stream, are recorded with the management information containing user-defined reproduction path information generated by a user specifying a starting point and an ending point for a desired part of the AV stream, and play list type information (PL_TY) indicative of whether content contained in the user-defined reproduction path is only video content, only still picture content, or a mixture of video and still picture content. This playback device comprises a presentation means (7805, 7806) for reading the play list type information, and displaying whether the user-defined reproduction path contains only video content, only still picture content, or a mixture of video and still picture content.

Brief Description Of Drawings

These and other objects and features of the present invention will be readily understood from the

following detailed description taken in conjunction with preferred embodiments thereof with reference to the accompanying drawings, in which like parts are designated by like reference numerals and in which:

Fig. 1 shows the logical structure of a disc according to a preferred embodiment of the present invention;

Fig. 2 shows the internal structure of an AV file for movies;

Fig. 3 shows the internal structure of an AV file for still pictures;

Fig. 4 shows the relationship between AV data and management information;

Fig. 5 shows the structure of the RTR_VMG block;

Fig. 6 shows the structure of the RTR_VMGI block;

Fig. 7 shows the VERN and TM_ZONE format;

Fig. 8 shows the structure of the PL_SRP block;

Fig. 9 shows the PL_TY and PL_CREATE format;

Fig. 10 shows the PTM format;

Fig. 11 shows the S_VOB_ENTN format;

Fig. 12 shows the structure of the M_AVFIT block;

Fig. 13 shows the V_ATR and A_ATR format;

Fig. 14 shows the SP_ATR and SP_PLT format for movies;

Fig. 15 shows the structure of the M_AVFI block;

Fig. 16 shows the structure of the M_VOBI block;

Fig. 17 shows the VOB_TY format;

Fig. 18 shows the structure of the TMAPI block;

Fig. 19 shows the VOBU_ENT format;

Fig. 20 shows the structure of the S_AVFIT block;

Fig. 21 shows the V_ATR and OA_ATRS_AA_STI format;

Fig. 22 shows the SP_ATR and SP_PLT format for still pictures;

Fig. 23 shows the structure of the S_AVFI block;

Fig. 24 shows the structure of the S_VOB_ENT block;

Fig. 25 shows the S_VOB_ENT_TY format;

Fig. 26 shows the structure of the UD_PGCIT block;

Fig. 27 shows the structure of the TXTDT_MG block;

Fig. 28 shows the structure of the PGCI block;

Fig. 29 shows the PG_TY format;

Fig. 30 shows the structure of the CI block;

Fig. 31 shows the C_TY format;

Fig. 32 shows the structure of the C_EPI block;

Fig. 33 shows the EP_TY1 format;

Fig. 34 is a block diagram of a DVD recorder drive;

Fig. 35 (a) shows the volume address space of a disc, and (b) shows the change in data accumulation in the track buffer;

Fig. 36 shows the correlation between picture types in an MPEG video system stream;

Fig. 37 shows the structure of an MPEG system stream;

Fig. 38 is a block diagram of an MPEG system decoder (P_STD);

Fig. 39 (a) shows video data, (b) shows the change in data accumulation in the video buffer, (c) shows the MPEG system stream, and (d) shows the audio data;

Fig. 40 is a block diagram of a DVD recorder;

Fig. 41 is used to describe to first exemplary play list presentation and selection screen;

Fig. 42 is used to describe to second exemplary play list presentation and selection screen;

Fig. 43 is a flow chart of a play list recording operation;

Fig. 44 is a flow chart of an operation for generating play list type information; and

Fig. 45 is a flow chart of a process for generating

a play list presentation screen.

Best Mode for Carrying Out the Invention

A DVD recorder and DVD-RAM disc are described below as a preferred embodiment of the present invention with reference to the accompanying figures.

Logical structure of DVD-RAM

The logical structure of a DVD-RAM disc is described first below with reference to Fig. 1. Fig. 1 shows the physical sector address area of the disc, and the structure whereby data is recorded to the disc as part of a file system.

The physical sector address area of the disc starts with a lead-in area to which a reference signal for servo stabilization, and an ID signal for differentiating DVD-RAM media from other media, are recorded. The user data area follows the lead-in area. Logically valid data is recorded to the user data area. A lead-out area ends the physical sector address area; a reference signal is also recorded here.

File system management information, called volume information, is recorded at the beginning of the user data area. The file system is not directly related to the present invention, and description thereof is thus omitted below. It should be noted, however, that by using a file

system, data recorded to the disc can be managed as files and a directory to the files as shown in Fig. 1.

All data handled by the DVD recorder is filed under the DVD_RTR directory directly below the root directory as shown in Fig. 1.

Files handled by a DVD recorder can be grouped into two broad categories: a management information file (RTR.IFO file) and one or more AV files (RTR_MOV.VRO file, RTR_STO.VRO file).

AV files are recorded as an RTR_MOV.VRO file recording moving picture content (referred to as video below), or an RTR_STO.VRO file recording still picture data and simultaneously recorded audio data.

Fig. 2 shows the file structure of an RTR_MOV.VRO file recording video content. As shown in Fig. 2, MPEG program streams (M_VOB (Movie Video Object)) are arranged in recording sequence in the RTR_MOV.VRO file.

Each program stream (M_VOB) is built from a plurality of Video Object Units (VOBU), each with a video reproduction time of 0.4 sec. to 1.0 sec.

Each VOBU comprises a number of video packs (V_PCK), audio packs (A_PCK), and subpicture packs (SP_PCK); each pack is 2 KB.

The video data in each VOBU further comprises

one or more Group of Pictures (GOP). The GOP is the decoding unit for MPEG video, starts with an I-picture, and contains plural P- or B-pictures.

Fig. 3 shows the structure of an RTR_STO.VRO file for recording still pictures and audio data. As shown in Fig. 3, an RTR_STO.VRO file contains S_VOB (Still Picture Video Objects), the MPEG program stream for still pictures, arranged in recording sequence.

The greatest difference between an S_VOB and M_VOB is that an S_VOB records still picture data instead of moving picture data, and the still picture data (video part) is followed by the audio data (audio part) instead of multiplexing the video and audio.

An S_VOB also contains one VOBU, which comprises a V_PCK, A_PCK, and SP_PCK.

AV data and management information

The relationship between M_VOB, S_VOB, and management information is described next below with reference to Fig. 4.

As described above, there are two types of AV data, M_VOB and S_VOB. Management information M_VOBI for each M_VOB is stored for each M_VOB where the M_VOBI records attributes of the corresponding M_VOB. Individually managing S_VOBs, however, would greatly

increase the amount of management information. Management information S_VOGI is therefore used to manage a group S_VOG containing plural S_VOB units. This S_VOGI records attributes for the corresponding S_VOB group.

What is important to note here is that MPEG stream data does not have a linear correlation between time and data size. As noted above, the MPEG system stream is compressed using temporal correlation characteristics and variable length coding techniques (including variable bit rate coding) in order to achieve high compression efficiency. As a result there is not necessarily a direct correlation between time and data size (address).

Therefore, an M_VOBI also contains a filter (TMAP) for converting time and address information, and an S_VOGI also contains a filter (S_VOB Entries) for converting a still picture number in an S_VOG group and address.

Management information for the reproduction path is described next below.

The reproduction path is defined as a program chain (PGC), that is, a sequence of cells, describing all or part of a range of M_VOB or S_VOG blocks.

The reproduction path can be either of two types: an original PGC referring to all AV data on the disc, or a

user-defined PGC defining a user-selected reproduction sequence of AV data on the disc. Note that a plurality of user-defined PGC can be recorded.

The original PGC is also called a Program Set having a Program layer logically bundling a plurality of cells.

A user-defined PGC is also called a Play List. Unlike an original PGC, a Play List does not have a Program layer.

Management information file

The content of the management information file RTR.IFO is described next below with reference to Fig. 5 to Fig. 33.

RTR_VMG (Fig. 5)

The VR_MANGR.IFO file contains real-time recording video management information RTR_VMG. RTR_VMG comprises seven tables: RTR_VMGI, M_AVFIT, S_AVFIT, ORG_PGCI, UD_PGCIT, TXTDT_MG, and MNFIT.

These seven tables are described in detail next below.

RTR_VMGI (Fig. 6)

Real-time recording video management information RTR_VMGI includes video management information table VMGI_MAT and play list search pointer

table PL_SRPT.

VMGI_MAT (Fig. 6)

The video management information management table VMGI_MAT stores the following information relating to the entire disc. The reproducing device and recording device, referred to as simply disc player and recorder, respectively, below, first read this VMGI_MAT to detect the overall structure of the disc.

VMG_ID (video management identifier)

Stores the identifier DVD_RTR_VMG0 identifying the disc as storing video recording data.

RTR_VMG_EA (RTR_VMG end address)

Stores the RTR_VMG end address.

VMGI_EA (VMGI end address)

Stores the VMGI end address.

VERN (version number)

Records the version number of the recording format of the stored video recording data according to the format shown in Fig. 7.

TM_ZONE (time zone)

Records the time zone used for all time information recorded to the disc. As shown in Fig. 7, the TM_ZONE stores a time zone stamp TZ_TY indicating whether time information is based on Greenwich Mean Time or a regional time standard (such as Eastern Standard Time

(EST) or Japan Standard Time (JST)), and a time zone offset TZ_OFFSET recording the time difference to Greenwich Mean Time.

STILL_TM (still time)

Stores the still time used for presenting still pictures without sound.

CHRS (character set code for primary text display)

Defines the character set code to use for primary text displays (described below).

M_AVFIT_SA (M_AVFIT start address)

Stores the start address of the movie AV file information table M_AVFIT. This start address is used in the seek operation for accessing the M_AVFIT table.

S_AVFIT_SA (S_AVFIT start address)

Stores the start address of the still picture AV file information table S_AVFIT. This start address is used in the seek operation for accessing the S_AVFIT table.

ORG_PGCI_SA (ORG_PGCI start address)

Stores the start address of the original PGC information. This start address is used in the seek operation for accessing the original PGC.

UD_PGCIT_SA (UD_PGCIT start address)

Stores the start address of the user-defined PGC information table. This start address is used in the seek operation for accessing the user-defined PGC information

table.

TXTDT_MG_SA (TXTDT_MG start address)

Stores the start address of the text data management information TXTDT_MG. This start address is used in the seek operation for accessing the text data management information TXTDT_MG.

MNFIT_SA (MNFIT start address)

Stores the start address of the management file information table MNFIT. This address is used in the seek operation for accessing the MNFIT table.

PL_SRPT (play list search pointer table) (Fig. 8)

The play list search pointer table PL_SRPT records play list search pointer table information PL_SRPTI and n play list search pointers PL_SRP.

PL_SRPTI (play list search pointer table information) (Fig. 8)

The play list search pointer table information PL_SRPTI records the following information for accessing a play list search pointer PL_SRP.

PL_SRP_Ns (number of play list search pointers)

Stores the number of play list search pointers PL_SRP.

PL_SRPT_EA (PL_SRPT end address)

Stores the end address of this play list search pointer table PL_SRPT.

PL_SRP (play list search pointer) (Fig. 8)

Records the following information for accessing the actual play list data, that is, the user-defined PGC.

PL_TY (play list type)

Stores one of the following values for identifying the play list type using the format shown in Fig. 9.

0000b: video only

0001b: still pictures only

0010b: both video and still pictures

0011b: audio only

PGCN (PGC number)

Stores the PGC number for the associated play list. The PGC number is the recording sequence of PGC information in the UD_PGCIT described below.

PL_CREATE_TM (play list creation date/time)

Stores the date and time the play list was created according to the format shown in Fig. 9.

PRM_TXTI (primary text information)

Stores text information indicative of play list content. For example, if the play list is a television program, PRM_TXTI could record the name of the show. PRM_TXTI

includes an ASCII code field, and a field for the character code set defined by the above-noted CHRS.

IT_TXT_SRPN (IT_TXT_SRP number)

If information indicative of the play list content is recorded as the optional IT_TXT block in addition to the above-noted primary text, the IT_TXT_SRP number is stored as a link to the IT_TXT recorded in TXTDT_MG. This IT_TXT_SRP number is the recording sequence in TXTDT_MG, described below.

THM_PTRI (thumbnail pointer information)

Stores thumbnail image information for the play list.

THM_PTRI (Fig. 8)

THM_PTRI stores the following information indicating a thumbnail image location.

CN (cell number)

Stores the cell number containing the thumbnail image. The cell number is the recording sequence of the cell information in the UD_PGCI for this play list.

THM_PT (thumbnail image pointer)

Stores the presentation time of the video frame used as the thumbnail image according to the PTM (presentation time) describing format as shown in Fig. 10 if the cell indicated by CN is a video cell. PTM is written

according to the reference time of the time stamp written in the MPEG program stream.

Stores the still picture VOB entry number of the still picture used as the thumbnail image according to the S_VOB_ENTN describing format as shown in Fig. 11 if the cell indicated by CN is a still picture cell.

M_AVFIT (Fig. 12)

The movie AV file information table M_AVFIT stores management information for the movie AV file RTR_MOV.VRO, and comprises M_AVFITI, M_VOB_STI, and M_AVFI.

M_AVFITI (movie AV file information table information) (Fig. 12)

Stores the following information for accessing M_VOB_STI and M_AVFI.

M_AVFI_Ns (movie AV file information number)

Indicates the number of following AVFI information fields. If 0, no AVFI is present; if 1, an AVFI is present. AVFI presence corresponds to the presence of movie AV file RTR_MOV.VRO.

M_VOB_STI_Ns (M_VOB_STI number)

Indicates the number of following M_VOB_STI fields.

M_AVFIT_EA (M_AVFIT end address)

Stores the M_AVFIT end address.

M_VOB_STI (movie VOB stream information) (Fig. 12)

Stores the following as movie VOB stream information.

V_ATR (video attributes)

Stores the following video attributes according to the format as shown in Fig. 13.

Video compression mode

Stores one of the following values indicating the video compression mode.

00b: MPEG_1

01b: MPEG_2

TV system

Stores one of the following values indicating the television system.

00b: 525/60 (NTSC)

01b: 625/50 (PAL)

Aspect ratio

Stores one of the following values indicating the aspect ratio.

00b: 4x3

01b: 16x9

line21_switch_1

Stores one of the following values indicating whether closed caption data for field 1 is contained in the video stream.

1b: recorded

0b: not recorded

line21_switch_2

Stores one of the following values indicating whether closed caption data for field 2 is contained in the video stream.

1b: recorded

0b: not recorded

Video resolution

Stores one of the following values indicating the video resolution.

000b: 720x480 (NTSC), 720x576 (PAL)

001b: 702x480 (NTSC), 702x576 (PAL)

010b: 352x480 (NTSC), 352x576 (PAL)

011b: 352x240 (NTSC), 352x288 (PAL)

100b: 544x480 (NTSC), 544x576 (PAL)

101b: 480x480 (NTSC), 480x576 (PAL)

AST_Ns (audio stream number)

Stores the number of audio streams recorded to the corresponding VOB.

SPST_Ns (still picture stream number)

Stores the number of still picture streams

recorded to the corresponding VOB.

A_ATR0 (audio stream 0 attributes)

Stores the following attributes for the audio recorded to audio stream 0 using the format as shown in Fig. 13.

Audio coding mode

Stores one of the following values indicating the audio compression method.

000b: Dolby AC-3

001b: MPEG audio without an extension stream

010b: MPEG audio with an extension stream

011b: linear PCM

Preference flag

Stores one of the following values indicating user preference information for the audio channel.

00b: not applicable

01b: audio channel 1

10b: audio channel 2

For example, if audio channel 1 is in Japanese, audio channel 2 is in English, and the user prefers to listen in English, this preference flag is set to 10b by the user.

Application Flag

Stores one of the following values indicating the audio application.

00b: not applicable

01b: plural audio channel configurations are mixed
10b: enhancement channel included

Note that a value of 01b indicating plural audio channel configurations are mixed means, for example, that two or more audio streams of monaural, stereo, or dual audio (such as in both Japanese and English) are recorded to the AV stream on separate time bases.

The enhancement channel is an enhanced audio channel for the visually impaired.

Quantization/DRC

Stores one of the following values for identifying whether dynamic range control (DRC) information is present.
00b: DRC not contained in MPEG stream
01b: DRC contained in MPEG stream

If LPCM is used, the following value is stored to identify the quantization level.
00b: 16 bit

fs

The following value is stored to identify the sampling frequency.
00b: 48 kHz

Number of Audio channels

Stores one of the following values indicating the number of audio channels.
0000b: 1 channel (monaural)

0001b: 2 channel (stereo)

0010b: 3 channel

0011b: 4 channel

0100b: 5 channel

0101b: 6 channel

0110b: 7 channel

0111b: 8 channel

1001b: 2 channel (dual monaural)

Dual monaural refers, for example, to a bilingual recording with main (e.g., Japanese) and sub (e.g., English) channels, both of which are monaural.

Bitrate

Stores one of the following values indicating the bitrate.

0000 0001b: 64 kbps

0000 0010b: 89 kbps

0000 0011b: 96 kbps

0000 0100b: 112 kbps

0000 0101b: 128 kbps

0000 0110b: 160 kbps

0000 0111b: 192 kbps

0000 1000b: 224 kbps

0000 1001b: 256 kbps

0000 1010b: 320 kbps

0000 1011b: 384 kbps

0000 1100b: 448 kbps

0000 1101b: 768 kbps

0000 1110b: 1536 kbps

What is important here is that if the corresponding audio stream is an MPEG audio stream with an extension stream, only the bitrate of the base stream, not including the extension stream, is recorded. This is because compression using a VLC technique is used for the extension stream, and the extension stream therefore cannot be defined using a fixed bitrate as above.

A_ATR1 (audio stream 1 attributes)

Stores the following attributes of audio stream 1 using the format as shown in Fig. 13. Note that these attributes are defined using the same fields used with A_ATR0 and described above, and further description is thus omitted here.

As shown in Fig. 43, if there are two audio streams (audio stream 1 and audio stream 2) for a single AV stream, A_ATR0 is used for audio stream 1 management information, and A_ATR1 is used for audio stream 2 management information. Because A_ATR0 and A_ATR1 are identical in structure, A_ATR0 shown on the bottom in Fig. 13 is also applicable to A_ATR1.

One possible application for two audio streams is to broadcast a baseball game, for example, with announcer

commentary for one team broadcast in stereo on audio stream 1, and the announcer commentary for the other team broadcast in stereo on audio stream 2.

If there is only one audio stream, that is, audio stream 1 in this case as shown in Fig. 44, A_ATR0 is used for the audio stream 1 management information while A_ATR1 is left blank or as initialized.

Furthermore, if audio streams 1 and 2 are both recorded for a single AV stream, A_ATR0 is used for audio stream 1 management information, and A_ATR1 is used for audio stream 2 management information. By setting the preference flag to 10b in A_ATR1 as shown in Fig. 45, audio channel 2, that is, the subchannel, can be designated the preferred channel and selected with priority to audio channel 1. Furthermore, by setting the application flag to 01b it is known that a plurality of audio channels are mixed. By further setting the number of audio channels to 1001b, it is known that two channel (dual monaural) audio is the preferred mode. Which is the preferred or representative mode when there are plural modes can be detected by, for example, comparing the total time of each mode and selecting the mode with the longest time, or sending a code in the broadcast signal indicating a preselected preferred mode.

SP_ATR (subpicture attribute)

Records the subpicture attribute information shown below according to the format as shown in Fig. 14.

Application Flag

Stores one of the following values indicating the application type.

00b: not applicable

01b: caption

10b: animation

SP_PLT (subpicture color palette)

Records the subpicture color palette information using the format shown in Fig. 14.

M_AVFI (Fig. 15)

The movie AV file information M_AVFI comprises the following information for accessing a movie VOB: M_AVFI_GI, M_VOBI_SRP, and M_VOBI.

M_AVFI_GI (movie AV file general information) (Fig. 15)

Stores the movie VOB information search pointer count M_VOBI_SRP_Ns.

M_VOBI_SRP_Ns (movie VOB information search pointer number)

Records the number of movie VOB information search pointers M_VOBI_SRP.

M_VOBI_SRP (movie VOB information search pointer)